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Corvallis Environmental Research Lab, Oreg

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

ROCK CREEK LAKE

JASPER COUNTY

IOWA

EPA REGION VII

WORKING PAPER No. 504

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Futrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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REPORT

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IOWA

EPA REGION VII

WORKING PAPER No. 504

WITH THE COOPERATION OF THE

IOWA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND THE

IOWA NATIONAL GUARD

AUGUST, 1976

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Iowa Department of Environmental Quality for professional involvement, to the Iowa National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Water Quality Division of the Department of Environmental Quality provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

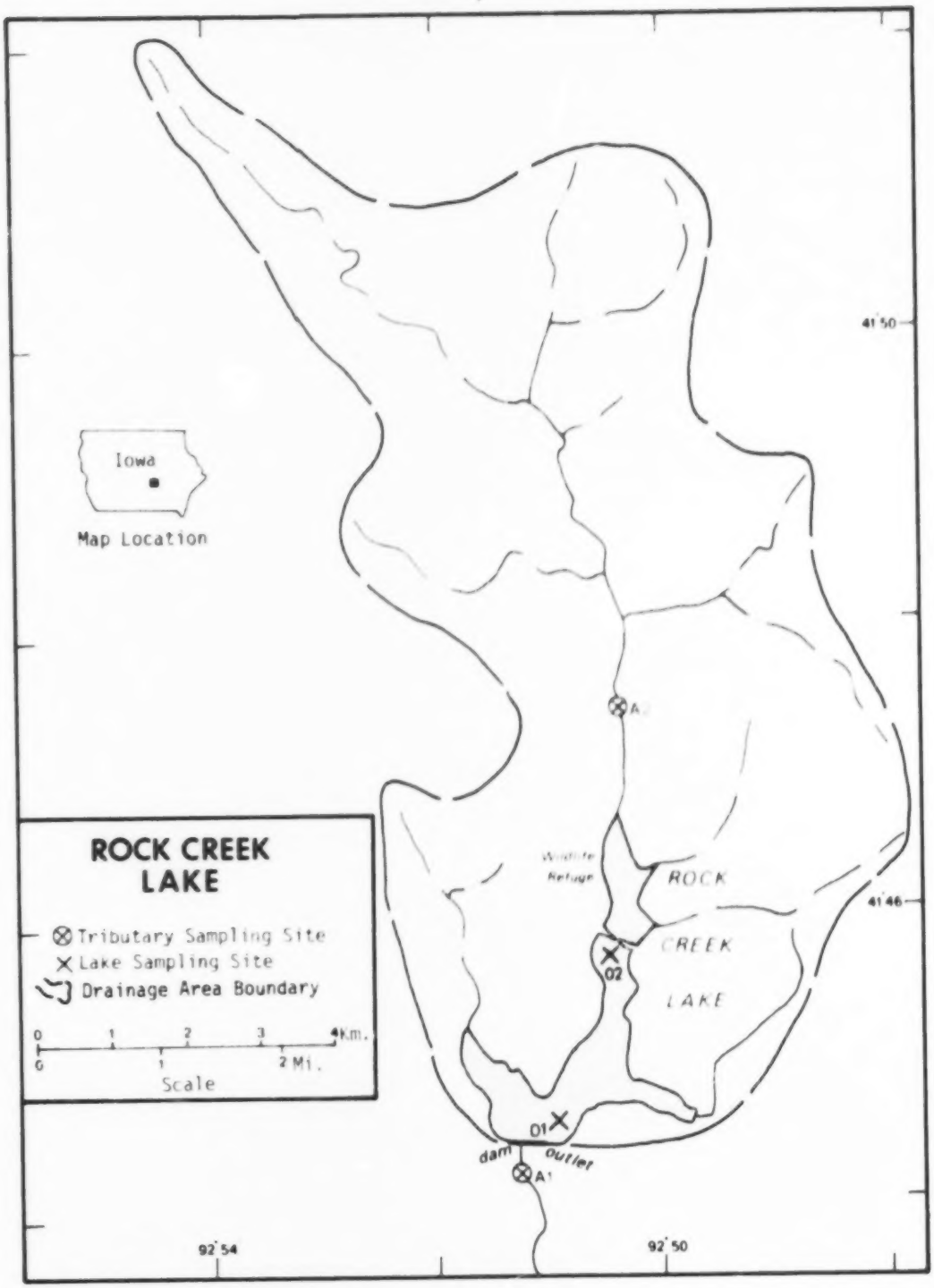
Major General Joseph G. May, the Adjutant General of Iowa, and Project Officer Colonel Cleadeth P. Woods, who directed the volunteer efforts of the Iowa National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF IOWA

LAKE NAME	COUNTY
Anquabi	Warren
Big Creek Reservoir	Polk
Black Hawk	Sac
Clear	Cerro Gordo
Darling	Washington
Lost Island	Clay, Palo Alto
MacBride	Johnson
Prairie Rose	Shelby
Rathbun Reservoir	Appanoose, Wayne
Red Rock Reservoir	Marion
Rock Creek	Jasper
Silver	Worth
Spirit	Dickinson
Viking	Montgomery
West Okoboji	Dickinson


ROCK CREEK LAKE
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 1 2 3 4 Km.
0 1 2 Mi.
Scale
Iowa
Map Location
41°50
41°46
92°54
92°50
A2
A1
01
02
dam
outlet
ROCK
CREEK
LAKE
Wildlife Refuge

ROCK CREEK LAKE

STORET NO. 1911

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate Rock Creek Lake is eutrophic. It ranked eighth in overall trophic quality when the 15 Iowa water bodies sampled in 1974 were compared using a combination of six parameters*. Seven of the water bodies had less median total phosphorus, none of the others had less but one had the same median dissolved phosphorus, ten had less median inorganic nitrogen and mean chlorophyll a, and 11 had greater mean Secchi disc transparency.

Survey limnologists noted beds of aquatic macrophytes along the shore near station 1 in July and an algal bloom at station 1 in September.

B. Rate-Limiting Nutrient:

The algal assay results show that Rock Creek Lake was phosphorus limited in April and September. The lake data indicate phosphorus limitation at all sampling stations and times.

C. Nutrient Controllability:

1. Point sources--There were no known point sources impacting Rock Creek Lake during the sampling year. Nonetheless, the present phosphorus loading of 3.12 $g/m^2/yr$ is

---

* See Appendix A.

six times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 11).

2. Non-point sources--The primary source of phosphorus was Rock Creek which contributed an estimated 64.7% of the total phosphorus load to the lake during the sampling year. The minor tributaries and immediate drainage area contributed an estimated 34.8% of the total load.

The phosphorus export rate of Rock Creek was a high 77 kg/km^2 during the sampling year. Since no point sources impact the stream, land-use practices must be the cause of the high export rate.

In a study of the Iowa Great Lakes, Bachmann and Jones (1973) found the variability in the phosphorus loads in the tributaries was highly correlated with the numbers of animal units (one animal unit = one beef animal) in the respective watersheds, and the 1969 Census of Agriculture (Anonymous, 1973) shows an animal density in the Rock Creek Lake area similar to that in the Iowa Great Lakes area. This suggests that a significant reduction in the Rock Creek phosphorus input may require control of animal wastes.

Reportedly, many ducks utilize the main portion of Rock Creek Lake during spring and fall migrations (Anonymous, 1972). However, waterfowl counts are not made routinely (Harrison, 1976), and the significance of nutrient contributions of migrating ducks cannot be determined.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 2.60 kilometers^2.
2. Mean depth: 2.7 meters.
3. Maximum depth: 6.7 meters.
4. Volume: 7.020×10^6 m^3.
5. Mean hydraulic retention time: 143 days.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Rock Creek	67.9	0.36
Minor tributaries & immediate drainage -	36.7	0.21
Totals	104.6	0.57

2. Outlet -

Rock Creek	107.2**	0.57

C. Precipitation***:

1. Year of sampling: 88.6 centimeters.
2. Mean annual: 87.6 centimeters.

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† Table of metric conversions--Appendix B.
†† Harrison, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Rock Creek Lake was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from two or more depths at two stations on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enume ation; and during the March and September visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 4.6 meters at station 1 and 1.5 meters at station 2.

The sampling results are presented in full in Appendix D and are summarized in the following table (the July nutrient samples were not preserved properly and were not analyzed).

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR ROCK CREEK LAKE
STORET CODE 1911

PARAMETER	1ST SAMPLING (6/19/74) 2 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/ 3/74) 2 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/24/74) 2 SITES RANGE	MEAN	MEDIAN
TEMP (C)	11.5 - 12.7	12.0	11.7	23.6 - 24.8	24.1	23.7	15.5 - 16.4	16.0	16.3
DISS OXY (MG/L)	10.4 - 13.8	11.9	11.4	6.6 - 7.4	6.9	6.8	7.0 - 8.2	7.7	8.0
CNDCTVY (MCROMO)	83. - 225.	146.	161.	368. - 455.	402.	369.	265. - 337.	321.	333.
PH (STAND UNITS)	8.6 - 8.7	8.7	8.7	7.8 - 8.0	7.9	7.8	7.8 - 8.0	7.9	7.9
TOT ALK (MG/L)	136. - 146.	140.	138.	****** -**********			192. - 194.	193.	194.
TOT P (MG/L)	0.061 - 0.071	0.065	0.065	****** -**********			0.056 - 0.073	0.067	0.069
ORTHO P (MG/L)	0.004 - 0.007	0.005	0.005	****** -**********			0.008 - 0.013	0.010	0.010
NO2+NO3 (MG/L)	2.210 - 2.390	2.314	2.320	****** -**********			0.280 - 0.310	0 294	0.290
AMMONIA (MG/L)	0.030 - 0.050	0.038	0.040	****** -**********			0.240 - 0.260	0.246	0.240
KJEL N (MG/L)	0.680 - 1.080	0.840	0.900	****** -**********			1.080 - 1.680	1.300	1.400
INORG N (MG/L)	2.250 - 2.420	2.352	2.370	****** -**********			0.520 - 0.550	0.540	0.550
TOTAL N (MG/L)	2.980 - 3.320	3.154	3.170	****** -**********			1.310 - 1.880	1.594	1.680
CHLRPYL A (UG/L)	24.4 - 34.9	29.6	29.6	4.2 - 18.7	11.4	11.4	13.5 - 14.5	14.0	14.0
SECCHI (METERS)	0.5 - 0.6	0.5	0.5	0.2 - 0.3	0.3	0.3	0.4 - 1.0	0.7	0.7

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/19/74	1. Cyclotella sp.	16,387
	2. Flagellates	712
	3. Cryptomonas sp.	574
	4. Chlamydomonas sp.	122
	5. Aphanizomenon sp.	52
	Other genera	243
	Total	18,090
07/03/74	1. Cryptomonas sp.	502
	2. Centric diatoms	413
	3. Nitzschia sp.	325
	4. Melosira sp.	59
	5. Lepocinclis sp.	59
	Other genera	118
	Total	1,476
09/24/74	1. Aphanizomenon sp.	2,759
	2. Cryptomonas sp.	690
	3. Flagellates	439
	4. Chlamydomonas sp.	313
	5. Crucigenia sp.	125
	Other genera	125
	Total	4,451

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/19/74	1	24.4
	2	34.9
07/03/74	1	4.2
	2	18.7
09/24/74	1	14.5
	2	13.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. April sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.010	2.220	0.2
0.050 P	0.060	2.220	18.7
0.050 P + 1.0 N	0.060	3.220	16.3
1.0 N	0.010	3.220	0.2

b. September sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.015	0.532	5.0
0.050 P	0.065	0.532	17.5
0.050 P + 1.0 N	0.065	1.532	30.0
1.0 N	0.015	1.532	4.9

2. Discussion -

The control yield of the assay alga, Selenastrum capricornutum, indicates that the potential primary productivity of Rock Creek Lake was low in April but was moderately high in September.

The results also indicate that Rock Creek Lake was phosphorus limited at those times. Note that the addition of only phosphorus resulted in a significant increase in yield but no increase in yield occurred with the addition of nitrogen only.

The mean lake inorganic nitrogen/orthophosphorus ratios also indicate phosphorus limitation; i. e,. the N/P ratios were 54/1 or greater at all sampling stations and times.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Iowa National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April and May when two samples were collected. Sampling was begun in August, 1974, and was completed in May, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Iowa District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the nutrient loads at station A-2, in $kg/km^2/year$, and multiplying by the ZZ area in km^2.

No known point sources impacted Rock Creek Lake during the sampling year.

* See Working Paper No. 175.

A. Waste Sources:

1. Known domestic -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Rock Creek State Park	?	stab. ponds	?	no discharge*

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Rock Creek	5,255	64.7
b. Minor tributaries & immediate drainage (non-point load) -	2,825	34.8
c. Known municipal STP's -	-	-
d. Septic tanks -	-	-
e. Known industrial -	-	-
f. Direct precipitation** -	45	0.5
Total	8,125	100.0

2. Outputs -

Lake outlet - Rock Creek 1,450

3. Net annual P accumulation - 6,675 kg.

* Ruchti, 1976.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Rock Creek	58,165	62.9
b. Minor tributaries & immediate drainage (non-point load) -	31,450	34.0
c. Known municipal STP's - None	-	-
d. Septic tanks - None	-	-
e. Known industrial - None	-	-
f. Direct precipitation* -	2,805	3.1
Total	92,420	100.0

2. Outputs -

Lake outlet - Rock Creek 70,375

3. Net annual N accumulation - 22,045 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Rock Creek	77	857

* See Working Paper No. 175.

E. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	3.12	2.57	35.5	8.5

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Rock Creek Lake.

"Dangerous" (eutrophic loading)	0.52
"Permissible" (oligotrophic loading)	0.26

V. LITERATURE REVIEWED

Anonymous, 1972. Rock Creek State Park brochure. IA Cons. Comm., Des Moines.

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Harrison, Harry M., 1975. Personal communication (lake morphometry). IA Cons. Comm., Des Moines.

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Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN SD	MEDIAN DISS INRG P
1901	LAKE ACQUABI	0.062	0.335	469.333	8.600	8.200	0.009
1902	BIG CREEK RESERVOIR	0.046	0.465	438.500	16.867	14.800	0.011
1903	BLACK HAWK LAKE	0.185	0.130	488.167	49.740	15.000	0.020
1904	CLEAR LAKE	0.059	0.070	465.125	17.400	8.600	0.010
1905	LAKE DARLING	0.077	1.475	482.500	13.817	9.200	0.012
1906	LOST ISLAND LAKE	0.146	0.065	421.167	36.100	8.400	0.021
1907	LAKE MACBRIDE	0.061	2.035	458.444	17.067	15.000	0.010
1908	PRAIRIE ROSE LAKE	0.056	0.210	463.667	17.350	8.600	0.010
1909	RATHBUN RESERVOIR	0.071	1.170	475.889	12.039	14.000	0.008
1910	RED ROCK LAKE	0.180	1.880	473.400	14.730	14.000	0.104
1911	ROCK CREEK LAKE	0.065	1.400	480.500	18.367	8.400	0.007
1912	SILVER LAKE	0.193	0.565	482.667	95.300	10.000	0.034
1913	SPIRIT LAKE	0.041	0.090	422.667	12.622	9.000	0.007
1914	VIKING LAKE	0.075	0.130	459.000	26.033	14.200	0.017
1915	WEST LAKE OKOBOJI	0.046	0.060	380.444	7.722	15.000	0.017

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
1901	LAKE ACQUAHI	57 (8)	50 (7)	43 (6)	93 (13)	100 (14)	79 (11)	422
1902	BIG CREEK RESERVOIR	89 (12)	0 (0)	79 (11)	57 (8)	21 (3)	50 (7)	296
1903	BLACK HAWK LAKE	7 (1)	68 (9)	0 (0)	7 (1)	7 (0)	21 (3)	110
1904	CLEAR LAKE	71 (10)	86 (12)	50 (7)	36 (5)	75 (10)	64 (8)	382
1905	LAKE DARLING	29 (4)	21 (3)	14 (2)	71 (10)	57 (8)	43 (6)	235
1906	LOST ISLAND LAKE	21 (3)	93 (13)	93 (13)	14 (2)	89 (12)	14 (2)	324
1907	LAKE MACBRIDE	64 (9)	7 (1)	71 (10)	50 (7)	7 (0)	64 (8)	263
1908	PRAIRIE ROSE LAKE	79 (11)	57 (8)	57 (8)	43 (6)	75 (10)	64 (8)	375
1909	RATHBUN RESERVOIR	43 (6)	36 (5)	29 (4)	86 (12)	39 (5)	86 (12)	319
1910	RED ROCK LAKE	14 (2)	14 (2)	36 (5)	64 (9)	39 (5)	0 (0)	167
1911	ROCK CREEK LAKE	50 (7)	29 (4)	21 (3)	29 (4)	89 (12)	96 (13)	314
1912	SILVER LAKE	0 (0)	43 (6)	7 (1)	0 (0)	50 (7)	7 (1)	107
1913	SPIRIT LAKE	100 (14)	79 (11)	86 (12)	79 (11)	64 (9)	96 (13)	504
1914	VIKING LAKE	36 (5)	64 (9)	64 (9)	21 (3)	29 (4)	32 (4)	250
1915	WEST LAKE OKOBOJI	89 (12)	100 (14)	100 (14)	100 (14)	7 (0)	32 (4)	428

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	1913	SPIRIT LAKE	504
2	1915	WEST LAKE OKOBOJI	428
3	1901	LAKE ACQUABI	422
4	1904	CLEAR LAKE	382
5	1908	PRAIRIE ROSE LAKE	375
6	1906	LOST ISLAND LAKE	324
7	1909	RATHBUN RESERVOIR	319
8	1911	ROCK CREEK LAKE	314
9	1902	BIG CREEK RESERVOIR	[illegible]
10	1907	LAKE MACBRIDE	263
11	1914	WIRING LAKE	250
12	1905	LAKE DARLING	235
13	1910	RED ROCK LAKE	167
14	1903	BLACK HAWK LAKE	110
15	1912	SILVER LAKE	107

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR IOWA 12/23/75

LAKE CODE 1911 ROCK CREEK RES.

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 107.2

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1911A1	107.2	0.28	0.87	1.40	0.78	0.91	1.07	0.62	0.21	0.20	0.21	0.22	0.15	0.57
1911A2	67.9	0.17	0.55	0.89	0.50	0.57	0.68	0.39	0.13	0.13	0.13	0.14	0.09	0.36
1911ZZ	39.4	0.10	0.32	0.52	0.29	0.33	0.39	0.23	0.08	0.07	0.08	0.08	0.05	0.21

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 107.2 TOTAL FLOW IN = 6.93
SUM OF SUB-DRAINAGE AREAS = 107.2 TOTAL FLOW OUT = 6.93

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
1911A1	8	74	0.23	17	0.18				
	9	74	0.07	14	0.07				
	10	74	0.08	19	0.06				
	11	74	0.28	16	0.27				
	12	74	0.34	13	0.34				
	1	75	0.22	11	0.20				
	2	75	0.16	22	0.18				
	3	75	1.22	16	0.31				
	4	75	0.85	5	0.65	19	0.68		
	5	75	0.48	18	0.42	25	0.37		
	6	75	1.02						
	7	75	0.48						
1911A2	8	74	0.16	17	0.13				
	9	74	0.05	14	0.05				
	10	74	0.05	19	0.04				
	11	74	0.21	16	0.19				
	12	74	0.22	13	0.22				
	1	75	0.14	11	0.12				
	2	75	0.10	22	0.11				
	3	75	0.76	16	0.28				
	4	75	0.54	5	0.40	19	0.42		
	5	75	0.31	18	0.26	25	0.23		
	6	75	0.71						
	7	75	0.27						
1911ZZ	8	74	0.09						
	9	74	0.03						
	10	74	0.03						
	11	74	0.12						
	12	74	0.13						
	1	75	0.08						
	2	75	0.06						
	3	75	0.45						
	4	75	0.31						
	5	75	0.18						
	6	75	0.42						
	7	75	0.16						

93
0

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 75/12/23

191101
41 44 27.0 092 51 20.0
ROCK CREEK LAKE
19 IOWA

11EPALES
4

2111202
0020 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/19	16 00	0000	11.7		25	83	8.70	138	0.050	1.000	2.320	0.007
	16 00	0005	11.5	11.4		161	8.65	137	0.040	0.800	2.210	0.005
	16 00	0015	11.5	10.4		225	8.60	136	0.040	0.600	2.380	0.007
74/07/03	09 30	0000	23.7	6.8	12	369	7.80					
	09 30	0005	23.7	6.6		369	7.80					
	09 30	0012	23.6	6.6		368	7.80					
74/09/24	09 30	0000	16.4	7.4	40	337	7.85	194	0.260	1.400	0.290	0.012
	09 30	0005	16.4	7.0		265	7.89	194	0.240	1.000	0.310	0.009
	09 30	0014	16.3	8.0		337	7.87	192	0.240	1.100	0.310	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/19	16 00	0000	0.064	24.4	
	16 00	0005	0.061		
	16 00	0015	0.071		
74/07/03	09 30	0000		4.2	
	09 30	0004			1.0
74/09/24	09 30	0000	0.056	14.5	
	09 30	0001			50.0
	09 30	0005	0.064		
	09 30	0006			1.0
	09 30	0014	0.072		

STORET RETRIEVAL DATE 75/12/23

191102
41 46 30.0 092 50 15.0
ROCK CREEK LAKE
19 IOWA

11EPALES 2111202
4 0007 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/19	16	15 0000	12.7		18	91	8.70	146	0.030	0.900	2.270	0.004
	16	15 0005	12.6	13.8		168	8.70	145	0.030	0.900	2.390	0.004
74/07/03	09	55 0000	24.8	7.2	8	455	8.00					
	09	55 0003	24.7	7.4		450	7.90					
74/09/24	10	00 0000	15.6	8.2	14	333	8.02	193	0.250	1.600	0.280	0.008
	10	00 0005	15.5	8.0		333	8.03	194	0.240	1.400	0.280	0.013

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/19	16	15 0000	0.065	34.9	
	16	15 0005	0.066		
74/07/03	09	55 0000		18.7	
74/09/24	10	00 0000	0.073	13.5	
	10	00 0001			50.0
	10	00 0005	0.069		
	10	00 0006			1.0

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/01/27

1911A1
41 43 20.0 092 51 00.0
ROCK CREEK
19125 JASPER CO HWY MP
0/ROCK CREEK RESERVOIR
BRDG JUST S OF ROCK CREEK STATE PARK
11EPALES 2111204
4 0000 FEET DEPTH

	DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
	74/08/17	15 20		1.680	1.100	0.095	0.010	0.045
SJ	74/09/14	14 10		0.490	1.000	0.050	0.015	0.055
SL	74/10/19	14 00		0.240	0.600	0.060	0.015	0.030
	74/11/16	13 30		0.480	1.500	0.270	0.015	0.070
	74/12/13	12 50		0.768	1.200	0.348	0.015	0.040
	75/01/11	10 15		1.160	1.700	0.352	0.020	0.050
	75/02/22			2.760	0.100	0.085	0.023	0.040
	75/03/16	14 00		1.500	1.050	0.270	0.010	0.060
	75/04/05	14 00		1.570	1.850	0.825	0.030	0.090
	75/04/19	14 30		1.570	2.000	0.720	0.030	0.100
	75/05/05	13 15		1.600	1.150	0.085	0.075	0.075
	75/05/25	13 30		1.500	0.700	0.100	0.005	0.040

STORET RETRIEVAL DATE 76/01/27

1911A2
41 49 00.0 092 50 00.0
ROCK CREEK
19 JASPER CO HWY MP
T/ROCK CREEK RESERVOIR
BRDG JUST N OF ROCK CREEK STATE PARK
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/08/17	15 50		4.700	0.600	0.035	0.055	0.110
74/09/14	13 45		2.880	0.900	0.045	0.040	0.110
74/10/19	13 47		2.640	0.700	0.090	0.035	0.080
74/11/16	13 50		4.700	0.600	0.075	0.040	0.180
74/12/13	13 15		4.700	0.900	0.100	0.035	0.140
75/01/11	10 35		3.680	1.900	0.432	0.065	0.300
75/02/22			2.610	0.100K	0.024	0.044	0.046
75/03/16	14 15		2.300	1.180	0.175	0.040	0.140
75/04/05	14 25		1.600	1.650	0.780	0.030	0.310
75/04/19	14 55		4.800	3.750	0.150	0.070	0.800
75/05/16	13 25		4.200	1.050	0.070	0.050	0.440
75/05/25	13 40		4.200	1.250	0.030	0.045	0.260

K VALUE KNOWN TO BE
LESS THAN INDICATED